

REMARKS

Interview Statement:

Applicants appreciate the Examiner's courtesy in granting the telephone interview of September 12, 2007 with the undersigned.

Independent claims 7 and 14 were proposed to be amended to recite that the semiconductor switch and the wiring board are covered with resin so as to render the semiconductor switch and the wiring board waterproof. The Examiner advised that he had not searched the prior art for this limitation, and therefore was unable to comment one way or the other.

The undersigned further presented a new claim for the Examiner's consideration, characterizing the air heater system of claim 1 as further comprising a resistance control means for controlling a resistance value of the electrothermal heating element. Given its broadest, reasonable interpretation, the Examiner considered the claimed electrothermal heating element to include the harness leading to the heater 39 as described in paragraph [0100] of Hada et al. Because Hada et al is said to disclose compensation for a variation in resistance of the harness by correcting the duty cycle, the Examiner considered that this passage meets the claimed control means for controlling a resistance value of the electrothermal heating element. The Examiner further cited paragraph [0099] of Hada et al as disclosing controlling the resistance value of the harness (and therefore the heater) based on current flowing through the heater 39.

As to claim 1, the Examiner considered the semiconductor switch as being met by a combination of transistor 26a, series resistor 26b, amp 26d and microcomputer 20 as shown in Fig. 3 of Hada et al. That is, the Examiner's view was that the combination of components

shown in Fig. 3 of Hada et al, in its entirety, is a semiconductor switch including a terminal for current detection (such as the terminal of microcomputer 20 receiving signal 1h). The Examiner further commented that Fig. 6 of the present specification looks similar to Fig. 3 of Hada et al, and suggested including further structure in claim 1, and specifically language characterizing the semiconductor switch, so as to distinguish over Hada et al.

Claim Amendments:

Claim 1 has been amended to recite that the air heater system comprises an electronic control unit receiving a current signal from the semiconductor switch and controlling on-off switching of the semiconductor switch in part based on the current signal; resistance value control means for controlling a resistance value of the electrothermal heating element based on output corresponding to the current which flows in the electrothermal heating element detected through the current detection terminal of the semiconductor switch, the electrothermal heating element heating said intake air, and means for detecting a voltage signal across the electrothermal heating element, the electronic control unit receiving the current and voltage signals to determine a resistance value of the electrothermal heating element, and the electronic control unit controlling a resistance value of the electrothermal heating element based on the current and voltage signals by on-off switching of the semiconductor switch.

Control of the resistance value R1 of the electrothermal heating element 120 is described, for example, at pages 35-36 of the specification. See also Fig. 4 where ECU 210 receives both current I2 and voltage V signals via electrical leads 184, 181. Particularly, the semiconductor switch 110 outputs current I2 from the fourth connector pin 114 at a predetermined ratio (e.g.,

1/21000) to the current I1 flowing through the electrothermal heating element 120. Also, the voltage drop V across the electrothermal heating element 120 is detected at terminal 150.

The subject matter of new claim 21 is described, for example, at page 36, lines 21-27 of the specification.

New claim 22 depending from claim 1 further characterizes the semiconductor switch as including a main body connected to the electrothermal heating element in series, a current detection circuit and a current detection terminal outputting a current signal at a predetermined ratio to current passing through the electrothermal heating element. This embodiment of the invention is also described at pages 35-36 of the specification and by reference to Fig. 4.

New claim 23 recites that the semiconductor switch has a current detecting function provided with a terminal for current detection to detect a current which flows in the electrothermal heating element without using a heater current detecting resistor placed in series with the semiconductor switch. That is, new claim 23 focuses on a specific problem solved by the present invention described at pages 2-3 of the specification. Specifically, as described at page 3, lines 1-6 of the specification, "When an additional resistance is inserted to detect the current flowing in the electrothermal heating element of the air heater, accordingly some defects may arise; e.g., voltage and current to be applied to the electrothermal heating element is largely reduced. The insertion of such additional resistance would also lead to an increase in size of the air heater system."

Claims 7 and 14 have been amended to correctly recite that the semiconductor switch and the wiring board are covered with resin so as to render the semiconductor switch and the wiring

board waterproof. Support is found, for example, at page 34, lines 12-17; at page 51, lines 18-21; and at page 52, lines 1-2 of the specification.

Entry of the amendments and review and reconsideration on the merits are requested.

Claims 1, 4, 7 and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. US 2002/0011484 A1 to Beetz et al in view of U.S. Patent Application Publication No. US 2002/0179443 A1 to Hada et al.

Claims 5, 6, 12, 13, 19 and 20 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Beetz et al in view of Hada et al, further in view of JP 07078671 to Hidetaka et al and U.S. Patent No. 5,057,672 to Bohlender et al.

Claims 3, 8-11 and 15-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Beetz et al in view of Hada et al, U.S. Patent Application Publication No. US 2001/0021093 A1 to Sommer et al and U.S. Patent No. 5,823,155 to Burner.

Applicants traverse, and respectfully request the Examiner to reconsider in view of the amendment to the claims and the following remarks.

Patentability of Amended Claim 1:

As claimed in amended claim 1, the electronic control unit controls a resistance value of the electrothermal element based on *both* current and voltage signals by on-off switching of the semiconductor switch. This characteristic feature of the invention is not taught, suggested or otherwise disclosed by any of the cited prior art.

In more detail, Hada et al discloses two examples, one is a correction using heater voltage as described in [0094] to [0096], and the other is a correction using heater current as described in [0097] to [0099]. That is, correction is performed based either on heater voltage or heater

current. However, Hada et al fails to teach correction based on the both the heater voltage and the heater current.

As described in [0095] and [0098] of Hada et al, and in its working examples, the correction is made based on the heater resistance R of a heater 39 regarded as constant. In other words, in Hada reference, the resistance R of the heater 39 is not considered as being a variable.

Further, Applicants respectfully disagree with the Examiner's understanding of the variation in resistance of a harness leading to the heater 39 in [0100].

This paragraph does not describe a case where the resistance of a specific harness lead in a specific heater control device varies with time. It mentions that a resistance of a harness lead used in many heater control devices varies *from harness to harness* and that such variation in resistance of the harness leading can also be compensated. In other words, it teaches that the resistance of the harness lead is constant in each heater control device, but the resistance values of the harness leads differ from one another based on comparison between the heater control devices. That is, in Hada et al, the resistance of the harness lead is not controlled. Rather, differences in resistance from one harness to another are compensated.

On the other hand, the air heater system of amended claim 1 is arranged to control a resistance of the electrothermal heater element. In addition, the resistance is controlled based on both a voltage signal and a current signal. Such configuration is not disclosed or suggested by the prior art.

Of course, Beetz et al has no disclosure of controlling the resistance of an electrothermal heating element based on both a voltage signal and a current signal, and therefore does not make up for the deficiencies of Hada et al.

Another distinction is that claim 1 (and also claims 7 and 14) is directed to an air heater system and apparatus for controlling energization of an electrothermal heating element (i.e., apparatus for controlling the temperature of a heater itself), whereas Hada et al is directed to temperature control of a sensor element rather than a heater. That is, in a gas sensor element, such as that disclosed by Hada et al, it is the temperature T_s of the sensor element that is held constant, but not the heater temperature T .

Patentability of Claims 7 and 14:

As recited in amended claims 7 and 14, the semiconductor switch and the wiring board are covered with resin so as to render the semiconductor switch and the wiring board waterproof. This characteristic feature of claims 7 and 14 is not taught, suggested or otherwise disclosed by any of the cited prior art.

More particularly, there is no description in Hada et al (directed to a power supply control system for a heater used in a gas sensor) of a resin, let alone a resin covering a semiconductor switch and a wiring board of an air heater system as required by present claims 7 and 14.

Beetz et al directed to an electric heating device, including a control board, also has no disclosure of a resin covering a semiconductor switch and a wiring board as required by amended claims 7 and 14.

Likewise, Sommer et al and Burner relating to a temperature-protected semiconductor circuit configuration and a control circuit for an incandescent element, respectively, also have no description of a semiconductor switch and wiring board of an air heater system covered with resin.

Thus, the combination of cited references does not disclose or suggest all of the limitations of claims 7 and 14, such that a *prima facie* case of obviousness has not been established.

For the above reasons, it is respectfully submitted that the amended claims are patentable over the cited references, and withdrawal of the foregoing rejections under 35 U.S.C. § 103(a) is respectfully requested.

Patentability of Claim 23:

As recited in independent claim 23, the semiconductor switch detects current which flows in the electrothermal heating element without using a heater current detecting resistor placed in series with the semiconductor switch and the electrothermal heating element.

To the contrary, in Hada et al, a current detecting resistor 26b is connected in series with the heater 39 and a transistor (a semiconductor switch) 26a.

In the present invention, only an electrothermal heater element 120 and a semiconductor switch 110 are connected in series as shown in Fig. 4. The invention of claim 23 includes no current detection resistor connected in series therewith, and therefore excludes the arrangement of Hada et al and specifically Fig. 3 of Hada et al including series resistor 26b for detecting current which flows in electrothermal heating element 120.

Withdrawal of all rejections and allowance of claims 1 and 3-23 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

AMENDMENT UNDER 37 C.F.R. § 1.114(c)
U.S. Application No.: 10/554,359

Attorney Docket No.: Q91021

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



Abraham J. Rosner
Registration No. 33,276

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE

23373

CUSTOMER NUMBER

Date: October 4, 2007